Spring 2018

An athletic training portfolio: 3 case studies

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An Athletic Training Portfolio: 3 Case Studies

An Honors College Project Presented to

the Faculty of the Undergraduate

College of Health and Behavioral Studies

James Madison University

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May 2018

Accepted by the faculty of the Department of Health Sciences, James Madison University, in partial fulfillment of the requirements for the Honors College.

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PUBLIC PRESENTATION
This work is accepted for presentation, in part or in full, at Virginia Athletic Trainers' Association on January 6th, 2018.

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Acknowledgements

I would like to express my gratitude to my capstone advisor and readers, Dr. Connie Peterson, Dr. Jamie Frye, and Ms. Maegan Michalik. I would also like to thank my preceptors, Marisa Maleike, Carolann Baldridge, and Dan Carroll for all of their assistance throughout this process.

Microdiscectomy and Degenerative Disc Disease in Female Collegiate Lacrosse Player: A Case Study

Background:

Lower back pain (LBP) is commonly reported throughout the general population, but it also presents itself in competitive athletes with approximately 30% of athletes reporting LBP at some point throughout their career.[1] Degenerative disc disease and lumbar disc herniation are both common causes of lower back pain. To understand these injuries, it is best to have an understanding of the anatomy of the spine. The spine is comprised of the cervical, thoracic, and lumbar regions. The lumbar region attaches to the sacrum and consists of 5 vertebrae. The thoracic and cervical region consist of 12 and 7 vertebrae respectively. The main anatomy of a vertebra includes the body, spinous process, and transverse processes. Between each vertebra, there is an intervertebral disc which acts as a cushion. The center of the disc is made out of nucleus pulposus and the outer, stronger ring is the annulus fibrosus (see figure 1). A herniated disc occurs when the annulus fibrosus is damaged and the nucleus pulposus moves out of the center and protrudes through the outer ring (see figure 2). Muscle imbalances can contribute to the occurrence of a herniated disc if the tight anterior abdominal muscles pull the pelvis and hip area into flexion, while weaker posterior trunk muscles fail to counterbalance and a neutral spine position is repeatedly compromised. A herniated disc can also be caused by degenerative disc disease, which weakens the annulus fibrosus from either aging or poor health habits such as smoking. Degenerative disc disease is often associated with genetic predisposition[1]. Another contributing factor to degenerative disc herniation is physical activity that creates traumatic forces on the lumbar region, specifically motions of flexion and twisting which force the disc to protrude posteriorly.

Pain reported in the lumbar region of the spine is often accompanied by pain or numbness shooting down the leg when a disc herniation occurs. This occurs because the nucleus pulposus presses on the spinal cord if it bulges posteriorly out of the disc.[2] The point of herniation may also be point tender with palpation and the area may feel stiff to both the patient and the clinician. The most common diagnostic tool for this injury is a magnetic resonance imaging (MRI). The MRI can visually show the bulging of the nucleus pulposus.

When disc herniation or degenerative disc disease is identified, treatment options include non-surgical and surgical. Non-surgical treatments include a period of rest (2-3 weeks), and then progressively more challenging stages that increase range of motion (ROM) and strengthening exercises before returning to play. The rehabilitation exercises should focus on reducing pain and increasing pelvic and core stability. Rest and rehabilitation effectively allows about 80% of athletes to return to sport participation, but may not be appropriate for extreme cases or individuals with repetitive problems.[1] Multiple factors impact the outcome of non-surgical treatments including patient compliance, degree of protrusion, and mechanism of injury. Another non-surgical option is epidural injections. The transforaminal, interlaminar, and caudual approaches are three possible routes for the injections. Epidural injections have been shown to successfully reduce pain levels to allow athletes to return to play in about 90% of cases, but they do not repair the injury.[3] Reducing pain levels may allow the patient to increase compliance with their rehabilitation exercises, which may be beneficial in repairing the injury. It is often suggested that epidural injections should be used in addition to rehabilitation protocols.[3] If the non-surgical options are not successful in relieving pain and returning the patient to full function, providers often turn to surgery.[1]

Patient:

A 19-year-old, single, Caucasian, female collegiate lacrosse player reported to the athletic training room complaining of low back pain that began the previous day at practice. The patient reported that the pain was beginning to affect her activities of daily living (ADLs), but she was still able to complete the tasks by avoiding motions that had evoked pain over the past day. Her chief complaint during the initial evaluation was a dull pain in her lower back that was not palpable, but she also reported that she had modified her running technique to compensate for the pain in an attempt to keep her back from going into flexion. In addition to her altered running technique, she stated that she had trouble bending over and then returning to a standing position. No numbness or tingling was reported. Even though there was a sudden onset of pain, there was not an exact mechanism of injury reported. Being that this patient had a very specific shooting technique that placed a lot of torque on her lower back; these forces were suspected as the mechanism. She had been playing lacrosse at a competitive level for many years, and the prolonged repetitive traumatic forces on her body from a very young age was suspected as contributing to the injury because of the load on the lumbar region of her back.

Findings:

Upon palpation, more rigidity was noted in her right erector spinae compared to her left. Hamstring flexibility was determined to be poor through hamstring flexibility testing and she was not able to bring her knees to her chest due to pain and stiffness in her low back with this lumbar flexion activity. Visual observation of posture suggested an anteriorly rotated pelvis. Hip flexion and extension strength were found to be a 5/5 with manual muscle testing. Positive tests included Gillet test for left (L) sacroiliac (SI) joint and abnormal movement of the L SI joint with both seated and standing SI joint movement tests. These tests suggest dysfunction if the movement of the SI joints differ during hip flexion in a seated and standing position. Positive tests are found when the movement patterns of the SI joint are not the same bilaterally. No discoloration or edema was observed.

Differential Diagnosis:

Based on these findings, it was believed that the patient had SI joint dysfunction and muscle tightness leading to mild low back discomfort. However, it could have also been the early signs and symptoms of a herniated disc.

Treatment:

The initial treatment consisted of lower extremity stretching, foam rolling for 15-20 minutes, ice, and a lower extremity rehabilitation plan. The stretching program included hamstrings, quadriceps, iliotibial band, hip flexors, gluteal, and low back. This rehabilitation plan included core stabilization exercises and hamstring and quadriceps strengthening exercises. With mild discomfort, the patient was able to continue playing; therefore, the treatment goals were aimed at correcting the SI Joint dysfunction, increasing flexibility in the lower extremities and reducing pain through the rehabilitation plan. As the end of the school year approached, two months after the initial evaluation, the patient was sent home with a summer plan that included the stretching program she had been completing, yoga, a back-maintenance program, and instructions to foam roll daily for 15-20 minutes. The back-maintenance program consisted of core and gluteus strengthening exercises that were to be performed daily.

Upon returning from summer break, five months after the initial injury, the patient reported increased low back pain and numbness/pain down her posterior left leg during ADLs.

She reported that she had consistently performed her rehabilitation plan over the summer, but the pain still increased gradually. She was referred to work with the team chiropractor two times a week. These appointments focused on lumbar spine extension exercises and abdominal bracing exercises for strengthening. Seven months after the initial injury, the patient reported an increase in pain and symptoms with an overall decrease in function. At this time, she was sent for an MRI which showed a left bulging disc at L5-S1 affecting the left S1 nerve root. Conservative treatment focusing on core strengthening and stabilization continued until later that month when the patient received a cortisone injection. The injection was supposed to reduce pain, but the patient reported increased pain. Nine months post-injury, the patient received an epidural injection. The patient also did not experience reduced pain from this treatment. Dry needling, topical cream, muscle relaxers, and lidocaine patches were also used on the lumbar region of her back with little to no improvement in function or decrease in pain reported by the patient.

Fourteen months after the initial injury, the patient was seen by an orthopedic surgeon who confirmed a bulging disc and degeneration of the lower two levels of the disc. The patient was given the option to continue conservative rehabilitation or undergo a discectomy. The patient chose to receive two L5-S1 nerve blocks as a diagnostic test to see if surgery would be effective in relieving her pain. After each nerve block, the patient experienced a 45% or more reduction of pain based on the pain scales used, so surgery was deemed a reasonable option.

Following a L5-S1 microdiscectomy surgery, the patient was restricted from lifting anything over 8 pounds, driving, or participating in any form of exercise above the level of walking. Treatments consisted of ice bags, walking, and ADLs as tolerated. She reported a significant decrease in pain after surgery. At three-weeks, she was allowed to begin driving. At 2-months she was cleared to begin light jogging, perform upper-body stretching and core strengthening exercises, play catch with her lacrosse stick, and begin light jumping. The rehabilitation program included short term goals of strengthening the core, lower extremities, and upper extremities and a long-term goal of returning to play with little to no pain during the next lacrosse season, approximately 19 months after the initial injury. The progressive plan can be seen in table 1. She was cautioned to progress into activities slowly and use pain, stiffness and soreness as guides. She was to avoid squats and dead lifts in the weight room. She successfully returned to limited play and conditioning activities three months post-surgery. These activities included a running progression and light stick work that contained limited twisting motions.

Uniqueness:

This case is important because of the different presentation of the initial injury, SI joint dysfunction, which was treated according to the initial findings and the patient experienced reasonable progression. As the injury persisted and pain increased, the patient was re-evaluated and diagnosed as having a lumbar disc herniation. A variety of conservative treatment options were pursued prior to surgery. Research supports that 6-8 weeks of conservative treatment be tried before surgery to help alleviate low back pain.[4] The patient in this case tried many forms of conservative treatments including extensive rehabilitation and multiple injections. Research suggests that athletes treated with conservative care only, are able to return to their sport 78.9% of the time within an average of 4.7 months after the start of rehabilitation.[5] However, rehabilitation exercises alone did not effectively treat the disc herniation of this patient.

The use of epidural injections for treating lumbar disc herniations has also been shown to be effective in allowing athletes to return to play quickly. The return to play rates of professional football players after being diagnosed with lumbar disc herniations found that 89% of the athletes only missed an average of 2.8 practices and 0.6 games.[6] The patient in this case did not benefit from the epidural injections, and continued to experience pain. If the epidural injections had worked to treat the disc herniation, her return to play time may have been significantly reduced.

As this patient continued to have pain that progressed down her left posterior leg after conservative treatment, she opted to progress to a surgical treatment option and had a lumbar microdiscectomy. Because athletes have more physical demands put on their bodies in order to participate in their sport, their overall rehabilitation time may be longer than non-athletes. The recovery time to return to ADLs may be similar between athletes and non-athletes, but the total rehabilitation time will be longer for athletes because they have to meet higher physical demands. The return to play rates of professional athletes after undergoing a microscopic lumbar discectomy found return to play after 3 months is 50%, 6 months is 72%, 9 months is 77%, and 12 months is 84%.[7] A systematic literature review found that 75%-100% of elite athletes were able to return to sport participation following lumbar discectomy. The return to play period ranged from 2.8 to 8.7 months for these athletes.[8] Our patient was allowed to return to limited conditioning and practice 3 months after surgery, suggesting that she was on track to return to full contact play within the time frames found in research.

Athletes should be advised to try conservative treatments for 6-8 weeks. If they do not experience progress, the athlete should consult with the orthopedic surgeon to determine if surgical intervention is an appropriate next step. It is important for clinicians to know how to handle this injury in case one of their patient's present with these symptoms. Clinicians also need to know the different treatment options. Treatment choices will vary based on the athlete's level of pain and preferences between conservation and non-conservative treatments.

Conclusion:

Low back pain in an otherwise healthy, young athlete can be difficult to pinpoint and manage. Typically, degenerative disc disease is caused by aging, predisposed genetics, and/or excessive forces during physical activity and can lead to a herniated disc. A herniated disc presents as low back pain and can often cause pain and/or numbness in the posterior leg from the compression of the nerve root as it leaves the vertebrae.

This patient experienced non-specific low back pain initially diagnosed as SI joint dysfunction. She progressed through early rehabilitation as expected, but eventually experienced additional symptoms. Conservative treatment was consistent with recommendations found in the literature and focused on stretching and strengthening the lower extremities and core. Injections, dry needling and pharmacological agents were also not successful in managing the disk herniation in a young, athletic female. Subsequently, the patient underwent a successful microdiscectomy. Following post-op rehabilitation, the patient was able to return to ADLs and sport participation within a time frame that is consistent with other athletic patients. While this path to resolution of pain and function was long, it is not uncommon for prolonged conservative care to proceed surgical intervention.

References

1. Burgmeier R, Hsu W. Spine surgery in athletes with low back pain-considerations for management and treatment. *Asian J Sports Med*. 2014; 5(4):e24284. doi: 10.5812/asjsm.24284.

2. Smith N, Masters J, Jensen C, Khan A, Sprowson A. Systematic review of microendoscopic discectomy for lumbar disc herniation. *Eur Spine J*. 2013; 22(11): 2548-2465. doi: 10.1007/s00586-013-2848-8.

3. Zhai J, Zhang L, Li M, et al. Epidural injection with or without steroid in managing chronic low back and lower extremity pain: A meta-analysis of ten randomized controlled trials. *Int J Clin Exp Med*. 2015; 8(6): 8304-8316. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4538092/.

4. Omidi-Kashani F, Hehrati H, Ariamanesh S. Ten important tips in treating a patient with lumbar disc herniation. *Asian Spine J*. 2016; 10(5): 955-963. doi: 10.4184/asj.2016.10.5.955.

5. Iwamoto J, Takeda T, Sato Y, Wakano K. Short-term outcome of conservative treatment in athletes with symptomatic lumbar disc herniation. *Am J Phys Med Rehabil*. 2006; 85: 667-674.

6. Krych A, Richman D, Drakos M, et al. Epidural steroid injection for lumbar disc herniation in NFL athletes. *Med Sci Sports Exerc*. 2012; 449(2): 193-198.

7. Watkins IV R, Hanna R, Chang D, Watkins III R. Return-to-Play outcomes after microscopic lumbar discectomy in professional athletes. *Am J Sports Med*. 2012; 40(11): 2530-2535. Doi: 10.1177/0363546512458570.

8. Nair R, Kahlenberg CA, Hsu WK. Outcomes of lumbar discectomy in elite athletes: the need for high-level evidence. *Clin Orthop Relat Res*. 2015; 473(6): 1971-7. doi: 10.1007/s11999-014-3762-z.

9. Ruetten S, Komp M, Merk H, Godolias G. Full-endoscopic interlaminar and transforaminal lumbar discectomy versus conventional microsurgical technique. *Spine*. 2008; 33(9): 931-939. DOI: 10.1097/BRS.0b013e31816c8af7.

Tables

Table 1. Herniated Disc Rehabilitation Exercises

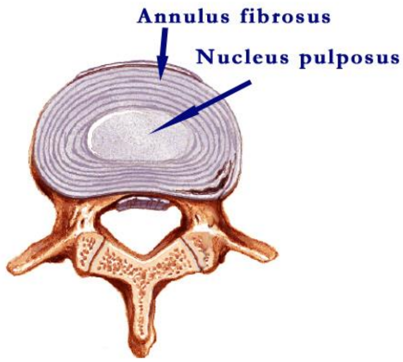
Time Frame	Rehabilitation Exercises
1-3 weeks post-surgery	Belly breathing
	Progressive Relaxation
	Intra-abdominal bracing
	Ankle pumps
	Short arc quad (SAQ)
	Long arc quad (LAQ)
3-6 weeks post-surgery	Seated bracing (2 minutes)
	Seated bicep curls (5lbs 2x10)
	Seated triceps extensions (5lbs 2x10)
	Seated IYT’s 2x10
	4-way ankle exercises (2x10)
	Double Leg (DL) Calf Raise (2x10)
	Short Arc Quad (2x15)

	Hamstring stretch on stool (2x30sec)
6+ weeks post-surgery	Stretches (hamstring, quadriceps, back extension/flexion) (alternating between upper extremities, lower extremities, and full body)
	Trigger point: quadriceps, hamstring, and piriformis
	Dead bugs (2min)
	Sit-ups (x10)
	Double leg bridge (2x10)
	Prone swimmers (x10)
	Quadruped arms or legs (x10)
	Wall slide w/ Physio-ball (x10)
	Physio-ball balance with leg press
	Single Leg (SL) calf raise (2x10)
	Total gym squats (DL 2x10, SL x10)
	Single leg balance (progressing from floor, to foam, to DynaDisc for 3x30sec)
	Lateral stepping (start with no resistance and progress to resistive bands)
	Step ups (medium box 2x10)
	Heel touch (small box 2x10)

	Planks (gradually increasing from 10 seconds to 30 seconds)
	Cardio (alternating between bike (20 minutes) and elliptical(20 minutes) at self-selected intensities)

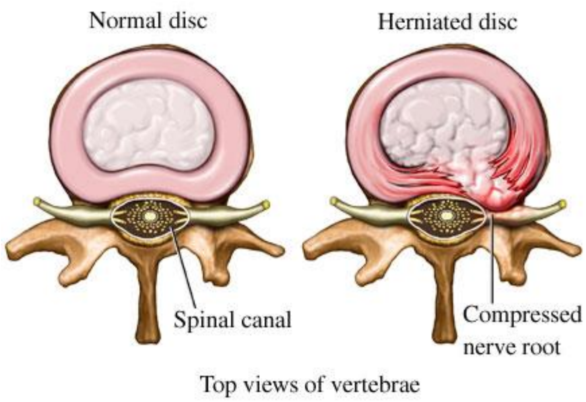
Figures

Figure 1. Lumbar Disc Anatomy



http://www.porcpotlas.hu/images/content/15/3.jpg

Figure 2. Herniated Disc



http://www.bakerchiropractic.org/wp-content/uploads/2011/08/Herniated-Disc.jpg

Venous Thoracic Outlet Syndrome with Associated Thrombosis: A Case Study

Introduction:

Thoracic outlet syndrome (TOS) is an unusual condition for the overall athletic population; however, it is commonly seen in athletes who use repetitive overhead motions in their sport. TOS is often misdiagnosed or not considered during an evaluation due to its rarity. TOS occurs when the nerves, arteries, and veins located in the thoracic outlet are compressed (See figure 1). This condition is classified into three subtypes including neurogenic, venous, and arterial depending on which structure is compressed.[1] Compression of these structures most commonly occurs because of an extra, or cervical, rib, the first rib, or a tight anterior scalene muscle.[2] When this vein is compressed, scar tissue begins to build up and decrease the blood flow through the vein. This compression can also lead to thrombosis in the subclavian vein.[3]

General symptoms for TOS include numbness and tingling down the arm, swelling of the affected extremity, changes in temperature or color of the extremity, and a feeling of achiness or soreness in the extremity. Venous TOS often presents with swelling at first and can also make the veins in the arm and chest become more pronounced.[2] If an individual is suspected of having venous TOS, they should be taken to the emergency room to determine if a blood clot is present. The diagnosis of TOS can be easily missed because of its rarity; therefore, a thorough evaluation should occur that consists of a patient history, physical examination, and imaging tests.[2] Once the diagnosis of venous TOS is determined, treatment can include conservative or non-conservative options. Conservative treatments include thrombolysis and blood thinning medications. This may also be accompanied by a surgical option of inserting a stent into the vein to open it up and allow more blood to flow through and relieving the compression of the vein by removing the first rib and/or part of the scalene muscle. There is currently a lack of research to determine if surgical options should automatically follow a stent insertion, or if surgery should be based on the results found in follow up visits after the stent insertion.[4]

Case Presentation:

The patient discussed in this case is a 22-year-old female collegiate softball player. The initial symptoms of the injury presented on March 7th, 2017. The patient was traveling with the team to a tournament when she reported to the certified athletic trainer with her initial symptoms.

The initial evaluation by the athletic trainer occurred the same day as the symptoms presented. The patient's chief complaint was swelling of the right upper extremity and red/purple discoloration from the fingertips to the shoulder (see figure 2). The patient had complained of general upper arm and trapezius tightness periodically in the past, but she had never reported incidents of swelling or pain. No specific mechanism of injury was present. The patient's capillary refill in her fingertips was present but slow. She also had 5/5 muscle strength when manual muscle tests were performed for the shoulder, elbow, and wrist (See Table 1). The patient had normal bilateral ROM. The athletic trainer referred her to the emergency room with suspicion of a blood clot and differential diagnoses of a strained muscle or a pinched nerve.

One day after the initial evaluation, the patient reported to the emergency room where she was traveling to receive testing to eliminate the possibility of a blood clot. The emergency room doctor diagnosed her with a strained muscle. When the patient returned to school 6 days after the initial evaluation, she was again referred to the emergency room because the athletic trainer and sports medicine team doctor were still concerned with the possibility of a blood clot. The second emergency room doctor diagnosed her with a blood clot in the right subclavian vein, thoracic outlet syndrome, and damage to the subclavian vein. The patient was given a prescription for Lovenex and Xarelto and referred to a vascular surgeon. Eight days after the initial evaluation, the patient met with the vascular surgeon and was admitted overnight to the hospital. She received a venogram that night, and again the next morning to track the effectiveness of the medicine in eliminating the blood clot. It was determined that the best course of action for this patient would be surgery to remove her first rib in order to decrease pressure on the subclavian vein. The patient elected to wait until her family was able to attend the surgery. The surgery occurred 16 days after the initial evaluation and included the removal of her right first rib and cutting a portion of the scalene muscle to alleviate the compression of the vein.

Throughout the process, the short-term goal of the patient and the athletic trainer was to eliminate the blood clot to avoid immediate danger to the patient's health. The long-term goal is to return to play with the permission of the vascular surgeon. Immediately after surgery, the focus of treatment was to allow the incisions to heal. After the first few days post-surgery, the patient began to work on breathing and range of motion exercises. Five days after surgery, she began her rehabilitation in the athletic training room (See Table 2).

Discussion:

This case is unique because of the misdiagnosis that occurred at the initial emergency room visit. It is commonly stated in the literature that misdiagnosis occur during an initial evaluation, but in this case the initial diagnosis was correct, and the referral evaluation was incorrect. If this diagnosis had been accepted and not followed up upon her return home, the patient could have been put in further danger if the blood clot had become dislodged and traveled to her brain.[2] Another unique aspect of this case is that the patient presented with vascular symptoms rather than neurological symptoms. Vascular presentation only accounts for about 5% of cases while 95% of the time it presents with neurologic symptoms. The vascular symptoms also occurred very rapidly and there were no indications prior to the onset of symptoms that the patient was at a high risk for TOS.

Three common techniques for decompression surgery include the supraclavicular, infraclavicular, and transaxillary approaches using video-assisted thoracoscopic surgery (VATS). There are few studies that compare the effectiveness and outcomes of these approaches; therefore, the literature is inconclusive on which approach is the gold standard.[5] In this case, the infraclavicular approach was used.

Vascular surgeons often prescribe the patient blood thinners after surgery to prevent more blood clots from forming. The time requirement for remaining on the blood thinners varies by surgeon, but the common timeframe is three months.[3] In this case, the patient was prescribed anti-coagulation medication for a minimum of 3 months. At her follow-up appointments in the future, the surgeon will determine if she needs to remain on the medication for longer or if she can stop taking it after the 3-month requirement. The time frame for taking the blood thinners may not be as important to some individuals, but this patient would like to continue playing softball at a competitive level in the future, and that may not be possible while she is on the blood thinners. This may be a unique aspect of this case in the future, because it may influence how long the doctor requires the patient to remain on the blood thinners.

Conclusion:

The injury presented in this case is venous thoracic outlet syndrome with an associated blood clot in the subclavian vein. The injury occurred from the compression of the subclavian vein as it runs through the thoracic outlet in the right shoulder. To alleviate the compression, the patient underwent surgery to remove the first rib and a part of the scalene muscle.

This case is unique because it initially presented as a vascular version of Thoracic Outlet Syndrome rather than neurologic. Ninety-five percent of TOS cases present with neurologic symptoms while the other 5 percent present with vascular symptoms. The patient underwent the infraclavicular approach during surgery which is still being researched to determine if it is the most effective approach to the decompression surgery. The case is also unique because the patient is a collegiate patient who has a long-term goal of returning to participation, which will not be possible if she remains on blood thinners.

References:

1. Ferrante M, Ferrante N. The thoracic outlet syndromes: Part 1. Overview of the thoracic outlet syndromes and review of true neurogenic thoracic outlet syndrome. *Muscle and Nerve*. 2017. Doi: 10.1002/mus25536.
2. Grunebach H, Arnold M, Lum Y. Thoracic outlet syndrome. *Vasc Med*. 2015; 20(5): 493-495. Doi: 10.1177/1358863X15598391.
3. Vemuri C, Salehi P, Benarroch-Gampel J, McLaughlin L, Thompson R. Diagnosis and treatment of effort-induced thrombosis of the axillary subclavian vein due to venous thoracic outlet syndrome. *J Vasc Surg*. 2016; 4(4): 485-500.
4. Stuck A, Engelberger R, Saengprakai W, Kucher N. Pharmacomechanical or ultrasound-assisted thrombolysis, balloon angioplasty and provisional surgical decompression for upper extremity deep vein thrombosis due to thoracic outlet syndrome. *Thromb Res*. 2016; 145: 109-111. Doi: 10.1016/j.thromres.2016.08.006.
5. Hosseinian M, Loron Ali, Soleimanifard Y. Evaluation of complications after surgical treatment of thoracic outlet syndrome. *Korean J Thorac Cadiovasc Surg*. 2017; 50(1): 36-40. Doi: 10.5090/kjtcs.2017.50.1.36.

Tables

Table 2. Manual Muscle Test Scores

Manual Muscle Test	Score
Shoulder abduction	5/5
Shoulder adduction	5/5
Shoulder Flexion	5/5
Shoulder Extension	5/5
Elbow Flexion	5/5
Elbow Extension	5/5
Wrist Flexion	5/5
Wrist Extension	5/5

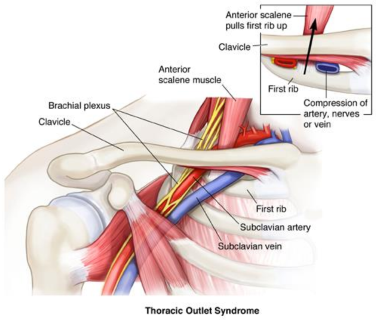
Table 3. TOS Rehabilitation Exercises

Week 1-2	
Rehabilitation Exercise	Repetitions/Sets
Shoulder Shrugs	1x10
Shoulder Blade squeeze	1x10
Cervical Rotation	1x10

Cervical Mobs (double chin)	1x10
Roll Thoracic Spine	3-4 rolls
Seated Lateral Arm Raise	1x10
Seated Forward Arm Raise	1x10
Wall Walks (side)	1x10
Wall Walks (front)	1x10
Diaphragm Breathing	1x10
Lateral Neck Bend	1x10
Chin to Chest	1x10
Week 2 Only	
Nerve Flossing	1x10
45 degree arm raise	1x10
Scapula Punch (supine)	1x10

Figures

Figure 3. Thoracic Outlet Syndrome



http://www.brighamandwomens.org/Departments_and_Services/lung-center/lung-diseases-and-conditions/thoracic-outlet-syndrome.aspx

Figure 4. Image of Affected Arm

(Picture included with patient's permission)

Grade II Medial Collateral Ligament Sprain: A Case Study

Introduction:

Medial Collateral Ligament (MCL) sprains are a common ligamentous injury in the knee. This injury is more common in male athletes that participate in higher level contact sports.[1] The MCL is the largest structure (8 to 10 cm) located on the medial aspect of the knee and is divided into a superficial and deep component (see Figure 1). The superficial component is also referred to as the tibial collateral ligament and is considered the primary static stabilizer against valgus stresses to the knee. The deep component is also referred to as the mid-third capsular ligament and is a secondary restraint to anterior translation of the tibia while also contributing to static stabilization against valgus stresses. MCL sprains can occur in athletics from a direct hit on the lateral aspect of a stationary knee or sudden changes of direction or speed. These actions put valgus stresses or rotational forces on the ligament which can cause strains or tears.[2] MCL injuries are classified as grade 1, 2, or 3. Grade 1 MCL sprains involve microscopic tears of either the superficial, deep, or both MCL components and only has associated pain without laxity. Grade 2 MCL sprains occur with partial tears of the ligament and may have increased laxity and pain. Finally, Grade 3 MCL tears include complete tears of the ligament and has significant valgus laxity.[3] The clinical presentation of a MCL sprain is tenderness to palpation over the MCL with associated swelling throughout the joint capsule and acute pain. The patient will often report the sensation of their knee giving out and feeling unstable. A valgus stress test can be used to determine the laxity of the MCL.[2] Magnetic resonance imaging (MRI) is the current gold standard to determine the grade of MCL sprains without the use of arthroscopy or surgical exploration. The common management of isolated Grade 1 and 2 MCL sprains is conservative management with early range of motion (ROM), strength, and functional components while still allowing for an adequate healing process. Grade 3 MCL sprains can be treated using conservative treatments or surgical options.[4] Athletes that begin early functional rehabilitation have a faster return to participation timeline compared to athletes that are immobilized or undergo surgery. The conservative treatment is a safe option that produces comparable effectiveness with a shorter rehabilitation.[5]

This case discusses a Grade 2 MCL sprain in a high school male football athlete. The injury occurred from a valgus force to a stationary leg. Conservative treatment was used to allow the patient to return to play. This case is unique because the patient was a senior athlete and had a goal to return to play by the final game of his senior year which was 4 weeks from the initial date of injury. This required a fast-paced rehabilitation program.

Case Presentation:

The patient in the case was a 17-year old male high school football player. The injury occurred on September 22nd, 2017 during a varsity high school football game. The patient was tackled and was not able to stand on his own, so the Certified Athletic Trainer and an Athletic Training Student ran out onto the field to assist him. Once the patient was determined to be stable and able to be transported, they helped him off the field. A quick side line evaluation was completed to determine that vascular and neural systems were still functioning correctly. Ice was applied and the patient was told to report to the athletic training room for a complete evaluation after the game.

During the initial evaluation after the game, the patient reported that he was chasing an offensive player to attempt to tackle him, when he was hit from behind by one player while another player landed on his knee creating a valgus force. He reported that he did not hear or feel a pop or crack when the injury occurred. The patient rated his pain as a 7 out of 10 on a numerical pain scale. The patient was unable to bear weight because of an unstable feeling and pain. The patient's chief complaint was pain and instability. Upon evaluation by the certified athletic trainer, there were no obvious deformities or signs of fractures or dislocations. Moderate swelling was observed on the medial aspect of the knee and on the proximal tibia. The patient was tender upon palpation over the medial aspect of the knee, over the MCL, anterior aspect of the patella, and lateral femoral ridge. The anterior drawer test and Lachman's test were both reported as unremarkable. The apprehension test was negative. The valgus stress test at 0 degrees and 30 degrees were both positive for pain and laxity. The differential diagnosis was a Grade 2 MCL sprain and consideration of anterior cruciate ligament (ACL) and/or meniscal involvement. The initial plan included crutch and brace fitting, applying ice, and referring to the pediatric doctor. Upon evaluation, the pediatric doctor referred the patient to an orthopedic doctor who agreed with the diagnosis of a Grade 2 MCL tear. Ten days after the initial injury, the orthopedic doctor gave permission for the patient to begin rehabilitation.

The modalities used during the rehabilitation included ice bags which were used immediately after rehabilitation and applied for 20 minutes. The patient was also instructed to wear a knee hinge brace during daily activities. During the first day of rehabilitation, manual muscle tests (MMT) were performed (Table 1) and ROM measurements (Table 2) were taken to determine the deficits of the injured knee.

The rehabilitation program began with ROM exercises and light strengthening. The activities progressed to full body weight bearing exercises as ROM and strength increased. Once strength reached 5/5 for manual muscle tests (MMT) and ROM was equal bilaterally, sport specific functional activities were incorporated (see Table 3). The patients's home program included passive flexion exercises using a towel and propping his ankle up when resting to regain full knee extension. The patient was not allowed to return to practice until he could complete a cutting cone drill, sprint, and complete hitting drills on the sled. The patient returned to practice for a week before participating in a full contact game. The hinge brace was a requirement and was worn when he returned to practice and games. The patient was able to return by his desired return to play date. The patient has not reported an instability or pain during practice or games. Upon re-evaluation, all strength MMT were 5/5 (Table 1) and ROM was equal bilaterally (Table 2).

Rehabilitation Documentation:

The long-term goal of the patient was to return to full game participation by 10/25/17 in order to play in the final game of his senior year. This was exactly 33 days after the date of the initial injury. In order to achieve this goal, the patient would have to be able to complete 20 single leg squats, run at 75% pace for 2 laps around the track, and complete a cone cutting drill in order to begin practicing a week before the game. To achieve these long-term goals, short term goals were created. The short-term goals included achieving 130 degrees of knee flexion, completing 10 half full squats, and being able to jog 2 laps by 10/15/17.

Discussion:

Current literature supports the use of conservative treatment for a Grade 2 MCL sprain; however, this case was unique because an accelerated rehabilitation used to return the patient to playing football. The official number of days out was 33 days; however, rehabilitation could not begin for 10 days after injury because that is the time needed to obtain permission from the Orthopedic doctor to begin rehabilitation. This means that the patient was able to return to play

22 days after the initial day of rehabilitation. This accelerated rehabilitation was used with caution to ensure that adequate healing was still occurring and the patient returned to play with a functional knee brace. Literature suggests using a long leg hinged brace for up to six weeks for Grade 2 MCL sprains and then progressing onto rehabilitation focused on ROM, strengthening exercises for lower extremity, and functional strengthening for return to play.[4] This patient used a brace throughout rehabilitation, but began ROM and strengthening exercises 10 days after the initial injury instead of waiting for up to 6 weeks.

The initial evaluation resulted in a differential diagnosis of a Grade 2 MCL sprain, but also considered the possibility of ACL and/or meniscal involvement. The patient was evaluated by his Pediatric doctor and was referred to an Orthopedic Doctor. The Orthopedic Doctor agreed with the differential diagnosis of a Grade 2 MCL sprain based on the history and evaluation techniques, and determined that an MRI was not required to support the diagnosis. This contradicts the literature which states that an MRI is the gold standard behind diagnostic arthroscopy and surgical exploration for diagnosing the grade of an MCL sprain and for eliminating the speculation of any other ligamentous or meniscal involvement.[2]

The patient progressed at a steady rate with visual and reported improvements. This can be seen through his continuous increased flexion and extension of his involved knee. This continuous progression allowed for an aggressive rehabilitation. The most difficult obstacle during the rehabilitation process was patient compliance. The patient was seen not wearing his brace and jogging during practice. The patient also forgot to come in for rehabilitation sessions or offered an excuse for skipping sessions on multiple occasions.

This case explores the possibility of a more aggressive and shorter rehabilitation of a Grade 2 MCL sprain. By controlling the swelling early in the rehabilitation, ROM was returned to normal quickly and strengthening could begin early in rehabilitation. If patient compliance could have been increased throughout the rehabilitation process, return to play may have been even quicker than what is seen in this case.

Conclusion:

The patient in this case is a 17-year old high school football player who received a valgus stress to a stationary knee during a football game. The stress resulted in a Grade 2 MCL sprain and the patiet was able to return to play 22 days after the start of rehabilitation, which was 33 days after the initial injury. This was a short rehabilitation time frame for a Grade 2 MCL sprain. Aggressive conservative rehabilitation was used to return the patient to play. The rehabilitation included ROM and strengthening exercises during the early stages. Strengthening exercises continued to increase in weight and difficulty until the patient could begin functional activities. Once the patient could complete sport specific activities, he was able to return to practice and then games 1 week later.

References:

1. Roach C, Haley C, Cameron K, et al. The epidemiology of medial collateral ligament sprains in young athletes. *Am J Sports Med*. 2014; 5(42): 1103-1109. Doi: 10.1177/0363546514524524.

2. Andrews K, Lu A, McKean L, Ebraheim N. Medial collateral ligament injuries. *J Ortho*. 2017; 14(4): 550-554. Doi: 10.1016/j.jor.2017.07.017.

3. Kim C, Chasse P, Taylor D. Return to play after medial collateral ligament injury. *Clin Sports Med*. 2016; 35(4): 679-696. Doi: 10.1016/j.csm.2016.05.011.

4. Edson C. Conservative and postoperative rehabilitation of isolated and combined injuries of the medial collateral ligament. *Sports Med Arthrox*. 2006; 14(2): 105-110. Doi: *10.1097/01.jsa.0000212308.32076.f2.*

5. Reider B, Sathy M, Talkington J, Blyznak N, Kollias S. Treatment of isolated medial collateral ligament injuries in athletes with early functional rehabilitation. *Am J Sports Med*. 1993; 22(4): 470-477.

Tables:

Table 4. Lower Extremity Manual Muscle Test Scores

	First Day of Rehabilitation (10/2/17)		Last Day of Rehabilitation (10/24/17)	
Manual Muscle Test	Left Leg (injured)	Right Leg	Left Leg	Right Leg
Hip Flexor	5/5	5/5	5/5	5/5
Gluteus Medius	3/5	4/5	5/5	5/5
Quadriceps	4/5	5/5	5/5	5/5
Hamstring	4/5	5/5	5/5	5/5
Gastrocnemius	5/5	5/5	5/5	5/5

Table 5. Range of Motion Measurements

	Knee Flexion		Knee Extension	
Date	Left Leg	Right Leg	Left Leg	Right Leg
10/2/17	118	134	3	2
10/3/17	120	136	3	4
10/4/17	123	132	1	1
10/6/17	124	132	1	3
10/10/17	126	135	1	2

10/11/17	126	134	1	2
10/15/17	127	135	1	2
10/17/17	132	136	1	1
10/18/17	135	138	4	1
10/19/17	134	135	2	1
10/20/17	134	134	2	1
10/23/17	132	135	2	1

Table 6. MCL Sprain Rehabilitation Exercises

	Straight Leg Raise	Weight Shifts	Leg Extensions Off Table	Abduction Straight Leg Raise	Towel Slides	Standing 3-Way Hip Exercises (flexion, extension, abduction)	Squats	SL Balance	Hamstring Curls	Jogging	Jumping	in-line run
10/2	2x10	20	2x10 (1.5 lbs)	2x10	20	X	X	X	X	X	X	X
10/3	2x10 (1.5 lbs)	20	2x10 (1.5 lbs)	2x10 (1.5 lbs)	20	2x10 Standing on Right Leg	X	X	X	X	X	X

						(red thera-band)						
10/4*	2x10 (no added weight)	X	2x10 (1.5 lbs)	2x10 (1.5 lbs)	20	2x10 (red thera-band)	10 (half squats)	2x30 seconds (with brace)	X	X	X	X
10/5	2x10 (1.5 lbs)	X	2x10 (2 lbs)	2x10 (1.5 lbs)	20	2x10 (red thera-band)	2x10 (half squats)	3x30 seconds (with brace)	X	X	X	X
10/6	2x10 (2 lbs)	X	2x10 (2lbs)	2x10 (2 lbs)	20	2x10 (red thera-band)	2x10 (half squats)	3x30 seconds (with brace)	X	X	X	X
10/10	3x10 (2.5 lbs)	X	3x10 (2.5 lbs)	3x10 (2.5 lbs)	X	2x10 both legs (red Thera-band)	2x10 (half squats)	3x30 seconds-eyes closed (with brace)	2x10 (no weight)	X	X	X
10/11	3x10 (2.5 lbs)	X	3x10 (2.5 lbs)	3x10 (2.5 lbs)	X	2x10 (red Thera-band)	2x10 (Half	3x30 seconds-eyes closed	2x10 (no weight)	X	X	X

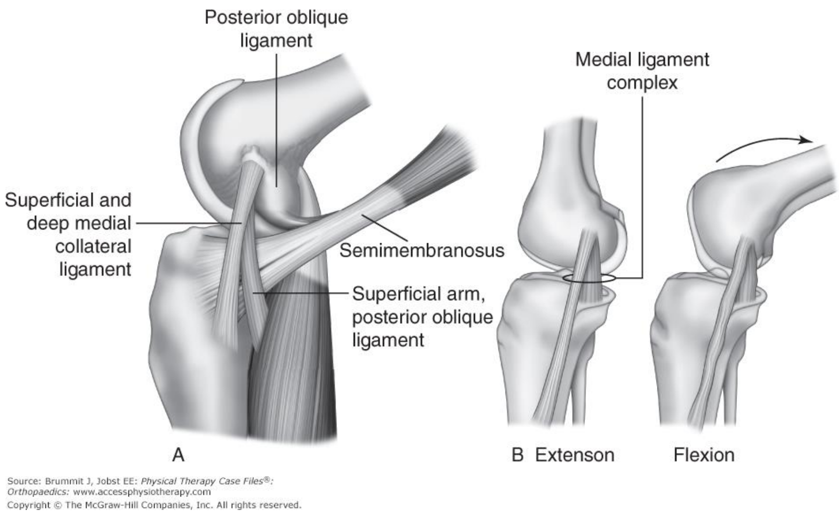
							squat)	(with brace)				
10/17	3x10 (4 lbs)	X	3x10 (4 lbs)	3x10 (4 lbs)	X	2x10 (red thera-band)	2x10 (full squats) and 2x10 (LSL)	3x30 seconds-eyes closed (without brace)	2x10 (2 lbs)	4 laps (40 % of max)	X	X
10/18	3x10 (4 lbs)	X	3x10 (4 lbs)	3x10 (4 lbs)	X	2x10 (red thera-band)	2x10 Full squats and 2x10 (LSL)	3x30 seconds on foam pad	2x10 (4 lbs)	6 laps (40 % of max)	2x20 forward /back and lateral line jumps	4 line runs at 60 % of max
10/19	3x10 (4 lbs)	X	3x10 (5 lbs)	3x10 (5 lbs)	X	2x10 (red thera-band)	2x10 full squats and 2x10 (LSL)	3x30 seconds on foam pad	2x10 (5 lbs)	8 laps (40 % of max)	2x20 forward /back and lateral line jumps	5 at 60 % of max
10/20	3x10 (5 lbs)	X	3x10 (5 lbs)	3x10 (5 lbs)	X	2x10 (red thera-band)	2x10 full squats	3x30 seconds on	2x10 (5 lbs)	8 laps (40 % of	2x20 F/B and lateral	5 at 60 % of

							and 2x10 (LSL)	foam pad		max)	line jumps	max
10/23	3x10 (5 lbs)	X	3x10 (5 lbs)	3x10 (5 lbs)	X	2x10 (red thera-band)	2x10 full squats and 2x10 (LSL)	3x30 seconds on foam pad	2x10 (5 lbs)	8 laps (40% of max)	2x20 F/B and lateral line jumps	X
10/24	2 laps at 40%, 2 line runs at 60%, 2 Line runs at 90-100% (sprinting), Cone cutting drill (x4), Hitting sled exercises **Cleared by doctor											

*Patient reported feeling very sore and painful before rehabilitation

Figures:

Figure 5. Medial Anatomy of the Knee



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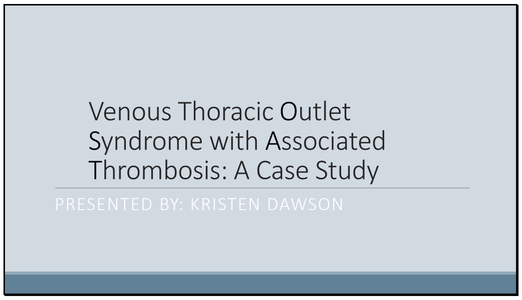
Appendix: Slide Presentation Virginia Athletic Trainers Association Annual Meeting and Symposium.

Slide 1



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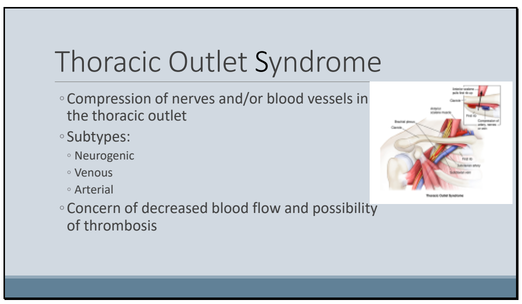

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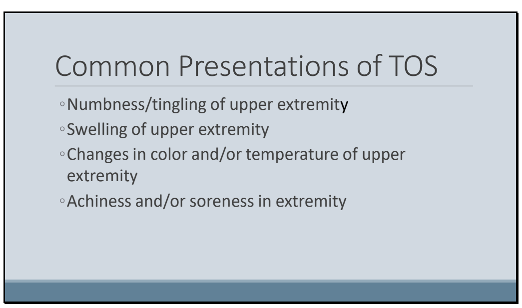


Slide 4

Personal Data

- 22-year-old
- Female
- Collegiate D1 Softball player
- No pertinent past medical history

Slide 5

Signs and Symptoms

- Upper extremity swelling
- Red/purple discoloration
- Normal Capillary refill/radial pulse
- 5/5 MMT
- Full bilateral ROM

Slide 6

Clinical Course

- Ultrasound imaging
- Diagnosis:
  - Blood clot in right subclavian vein
  - Thoracic Outlet Syndrome
  - Damaged right subclavian vein

Slide 7

Clinical Course

Treatment:

- Lovenex and Xarelto (minimize blood clotting)
- Surgery (infraclavicular) to remove first rib and section of scalene muscle
- Rehabilitation program focusing on neck and shoulder ROM, light strengthening, and breathing exercises

Slide 8

Expected Outcome

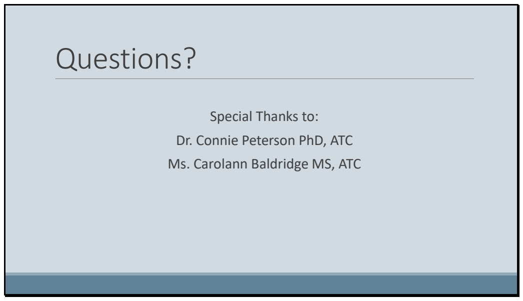
- Return to play:
  - Full strength and ROM
  - Cleared by doctor to stop taking blood thinning medication
- Actual outcome unknown because athlete returned to Australia

Slide 9

Deviations from Expected

- TOS neurological symptoms usually present gradually
- Multiple surgical options
  - Infraclavicular vs supraclavicular or transaxillary

Slide 10


Questions?
Special Thanks to:
Dr. Connie Peterson PhD, ATC
Ms. Carolann Baldridge MS, ATC

Summary

This Honors Capstone Project began with the accumulation of 3 case studies that are mandatory components of the Athletic Training Program at James Madison University. Each case study was reviewed and edited by Dr. Peterson, the advisor for this project, and the readers. The Microdiscectomy and Degenerative Disc Disease in a Female Collegiate Lacrosse Player Case Study was edited and formatted to be submitted to the National Athletic Trainers' Association Student Writing Contest. The results of the contest have not yet been released. I also submitted an abstract for The Venous Thoracic Outlet Syndrome with Associated Thrombosis Case Study and was selected to present the case study at the Virginia Athletic Trainers' Association Annual Meeting and Symposium. Additionally, I created and implemented the rehabilitation program for the Grade II Medial Collateral Ligament Sprain Case Study. This capstone project has allowed me to gain additional experience with the scientific writing process that I would not have accumulated otherwise. I have learned that the publication submission process is very rigorous, yet also incredibly rewarding. I believe that this project not only has allowed me to grow as a scientific writer, but has also allowed me to improve my ability to understand and utilize evidence based practice research completed and published by others. Both of these skills will help me to improve my clinical practice as a young professional.